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HISTIOTEUTHIS BONNELLII (CEPHALOPODA: HISTIOTEUTHIDAE) IN THE ADRIATIC SEA: EVIDENCE FROM PREDATOR STOMACH CONTENTS (**)

KEY WORDS: Cephalopoda, *Histioteuthis bonnellii, Prionace glauca, Xiphias gladius*, stomach content, Adriatic Sea.

Summary

Remains of 15 specimens (juvenile to adult) of *Histioteuthis bonnellii* were found in the stomach contents of two blue sharks, *Prionace glauca*, and one swordfish, *Xiphias gladius*, caught in the South Adriatic Sea. The occurrence of this cephalopod had not been previously reported in the Adriatic. The relationship between the rostral lengths of upper and lower beaks of *H. bonnellii* was taken into account; while the ratio URL/LRL is constant in immature pairs of beaks, it increases in mature pairs.

Riassunto

Nel contenuto gastrico di due verdesche, *Prionace glauca*, e di un pesce spada, *Xiphias gladius*, pescati nell'Adriatico meridionale sono stati rinvenuti i resti di 15 esemplari (giovani ed adulti) di *Histioteuthis bonnellii*. La presenza di questo cefalopodo può così essere registrata anche in Adriatico. Grazie alle mandibole di *H. bonnellii* trovate nei contenuti stomacali, è stato studiato il rapporto fra le lunghezze rostrali dei 'becchi' superiore ed inferiore; esso è costante nelle coppie di mandibole immature, mentre aumenta in quelle mature.

Introduction

The umbrella squid, *Histioteuthis bonnellii* (Férussac, 1835) (Teuthoidea: Histioteuthidae), is a pelagic cephalopod distributed throughout the North Atlantic south of approximately 50°N, in the Mediterranean Sea, and in the Indian Ocean off South Africa. Individuals have been taken at depths of 70 to 2,000 m (Voss, 1969).

Its Mediterranean distribution is concisely reported by MANGOLD & BOLETZKY (1987) in a map. The Adriatic Sea is not included in the geographical range of the species.

Remains of several umbrella squids were found in the stomach contents of two blue sharks, *Prionace glauca* (Linnaeus, 1758), and one swordfish, *Xiphias gladius* Linnaeus, 1758, caught in the southern Adriatic. Thus, the distribution of *H. bonnellii* is now extended to this sea (see also BELLO, 1990a).

This cephalopod, in spite of its rare captures by net, is a frequent prey of pelagic predators (Voss, 1969; CLARKE, 1986; CLARKE *et al.*, 1993).

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Material and methods

The two blue sharks and one swordfish containing *Histioteuthis bonnellii* remains were caught by drifting longline in the South Adriatic, on bottoms exceeding 500 m in depth, in July 1990.

The blue sharks weighed about 12 kg each (dressed weight) and the swordfish about 130 kg (dressed weight).

Beaks were identified using Voss (1969) and CLARKE (1986), and by comparison with examples removed from whole specimens of known identity. Beak terminology follows CLARKE (1986).

Mantle lengths were estimated (EML) from rostral lengths of lower beaks (LRL) by the regression equation given by CLARKE (1986).

Results

In all, remains from 15 *Histioteuthis bonnellii* specimens were counted. Table 1 summarizes the information about the type of remains found, beak measurements and conditions, and squid estimated size.

The body fragments of the adult squid from the swordfish stomach bore the signs of having been repeatedly slashed by the swordfish bill (Fig. 1). The squid had been hit by at least four parallel strokes before being ingested (Fig. 2).

Fig. 1 - Remains of an adult *Histioteuthis bonnellii* found in the swordfish stomach content: part of the head with cartilaginous capsule, buccal mass with short stumps af arms, fragments of three arms with remains of web and suckers, fragment of tentacle, pieces of skin. Scale bar: 5 cm.

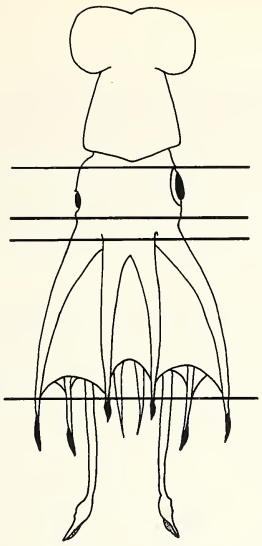

Fig. 2 - Supposed slashing pattern on the *Histioteuthis bonnellii* adult specimen from the swordfish stomach (see also Fig. 1).

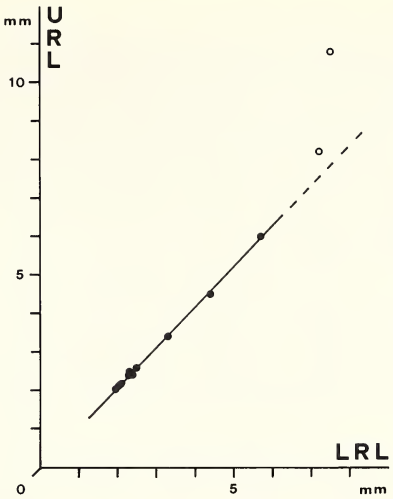

Fig. 4 - Upper rostral length plotted against lower rostral length for 12 pairs of *Histioteuthis bonnellii* beaks. Filled circles = immature beaks; open circles = mature beaks. The regression line refers to the pairs of immature beaks only

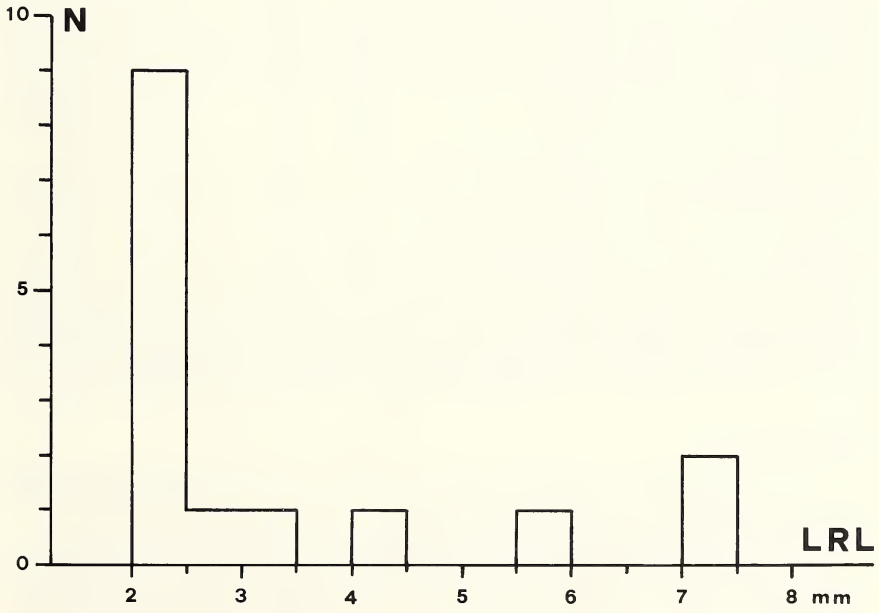

Fig. 3 - Lower rostral length frequency distribution for *Histioteuthis bonnellii* beaks found in two blue sharks and one swordfish from the Adriatic Sea; n = 15.

In addition to *H. bonnellii* remains, the stomach of blue shark no. 2 contained a fragment of a large bony fish (a bait mackerel, most probably) and eight bird feathers; the swordfish stomach contained a pair of beaks from a juvenile *Histioteuthis reversa* and several small sized bony fishes.

The lower rostral length (LRL) frequency distribution (Fig. 3) suggests that adult individuals (7.0-7.5 mm LRL class = 14.5-15.5 cm EML class) coexist together with young (peak at 2.0-2.5 mm LRL class = 2.5-4.0 cm EML class).

It was possible to match each available upper beak to its companion lower beak, in all cases (Table 1). The plot of upper rostral length (URL) against LRL follows a straight line in the case of immature beaks, i.e. beaks with transparent wings (in lower) and strips (in upper beaks) (Fig. 4). The regression equation for the pairs of immature beaks is:

$$URL = 0.002 + 1.041\ LRL;\ r = 0.999;\ n = 10.$$

Hence the ratio URL/LRL is constant and very close to 1 in the pairs of immature beaks (range: 1.00-1.09; mean = 1.04), whereas it increases in the pairs of dark-winged beaks (URL/LRL = 1.14 and 1.44). Such an increase is apparently due to the loss of cartilage at the upper beak «false jaw angle» (Clarke, 1962: Fig. 2E).

Predator	Type of remains	URL	URL	Beak maturity	EML
Blue shark no. 1	flesh	2.5	2.3	I	3.7
Blue shark no. 1	flesh	6.0	5.7	I	11.3
Blue shark no. 1	beaks	2.1	2.0	I	3.1
Blue shark no. 1	beaks	2.2	2.1	I	3.3
Blue shark no. 1	beaks	2.2	2.1	I	3.3
Blue shark no. 1	beaks	2.4	2.3	I	3.7
Blue shark no. 1	beaks	2.4	2.3	I	4.0
Blue shark no. 1	beaks	2.6	2.5	I	4.2
Blue shark no. 1	beaks	4.5	4.4	I	8.4
Blue shark no. 1	beaks	10.8	7.5	M	15.3
Blue shark no. 2	beak	—	2.3	I	3.7
Blue shark no. 2	beak	—	2.4	I	4.0
Swordfish	flesh	8.2	7.2	M	14.6
Swordfish	buccal mass	3.4	3.3	I	6.0
Swordfish	beak	—	2.3	I	3.7

Table 1 - *Histioteuthis bonnelli* remains found in two blue sharks and one swordfish from the Adriatic Sea. URL = upper rostral length (mm); LRL = lower rostral length (mm). Beak maturity: I = immature beaks; M = mature beaks. EML = estimated mantle length (cm).

Discussion

The find of *Histioteuthis bonnellii* remains at an early digestion stage in the stomachs of predators caught in the South Adriatic, proves the presence of such species in this sea (*cf.* Dunning *et al.*, 1993). Furthermore, the size diversity of *H. bonnellii* beaks shows that the population comprises young and adults. Kohler e Stillwell (1981) report that blue sharks are opportunistic feeders and apparently feed on the most abundant and easily accessible food supplies, so that the presence of several beaks suggests that *H. bonnellii* is common in the region where the predators were caught.

Bello (1991) already reported, with no remarks, the find of a buccal mass (LRL = 10.6 mm) and an upper beak (URL = 4.1 mm) of *H. bonnellii* in the stomach contents of a swordfish caught in the Adriatic in July 1985. Beaks of 40 *H. bonnellii* specimens were extracted from the stomach of a Risso's dolphin stranded on the South-West Adriatic coast (Bello, 1992); it was not possible to establish where the dolphin had fed before dying. Lastly, remains of a juvenile *H. bonnellii* — a buccal mass and four arms; LRL = 1.8 mm — were found in the stomach of a blackmouth catshark from the south Adriatic (Bello, in press).

The presence of *H. bonnellii* in the South Adriatic can be related to the large NW inflow from the north-eastern Ionian Sea through the Otranto Straits, which prevails in the intermediate layer (about 40-400 m) throughout the year (Zore-Armanda, 1963). Such currents widely connect the South Adriatic to the North Ionian, where umbrella squids also occur (Kaspiris & Tsiambos, 1986).

Bello (1990b) examined the stomach contents of five blue sharks from the Gulf of Taranto; remains of histioteuthid squids were found in four of them (3 *H. bonnellii* and 2 *Histioteuthis reversa* specimens). Histioteuthids were also found in the stomach contents of blue sharks caught off Eastern Australia (Dunning *et al.*, 1993).

Several authors have reported that the swordfish use the bill to wound or kill its prey (*cf.* Bello, 1991). Further evidence of this is offered by the flesh remains from the adult *H. bonnellii* described in the results section (Fig. 1). According to Vecchione (*in litteris*) histioteuthid squids have «a very characteristic posture, with the arms and tentacles curled above the head, forming a 'squid ball'. When disturbed, they straighten out and swim rather slowly and obliquely upward». The slashing pattern on the histioteuthid squid found in the swordfish stomach (Fig. 2) suggests that the squid had probably straightened out and was fleeing when hit by the predator bill.

As concerns the beaks of *H. bonnellii* from the Adriatic, wing darkening occurs somewhere between 5.7 and 7.2 mm LRL. In Atlantic specimens wings darken at 6.0 to 9.0 mm LRL (Iceland), <8.7 mm LRL (Madeira) (Clarke, 1986), and 7.7 to 9.5 mm LRL (Azores) (Clarke *et al.*, 1993). The drastic change in the ratio URL/LRL with beak growth and darkening requires further investigation. Nevertheless URL/LRL is fairly stable in undarkened beaks (up to 5.7 mm LRL and 6.0 mm URL in the presently available sample), to be used in estimating an umbrella squid ML and weight when only the upper beak is available.

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